AIR FORCE

QUALIFICATION TRAINING PACKAGE (AFQTP)

for

UTILITIES SYSTEMS

(3E4X1)

MODULE 15

WASTEWATER SYSTEMS

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MODULE 15

WASTEWATER SYSTEMS

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

OPR: HQ AFCESA/CEOT

Certified by: HQ AFCESA/CEO
(Colonel Lance C. Brendel)

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INTRODUCTION

Before starting this AFQTP, refer to and read the "Trainee/Trainer Guide" located on the AFCESA Web site **http://www.afcesa.af.mil/**

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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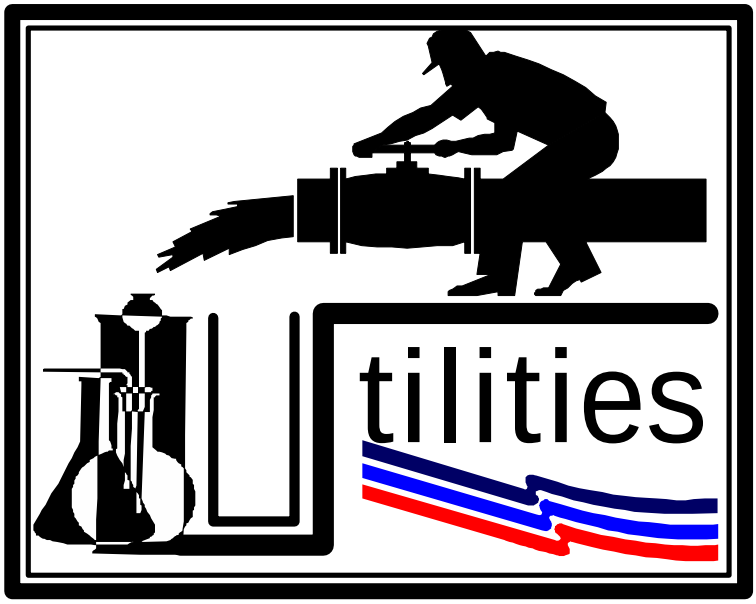

INSTALL WASTEWATER SYSTEMS COMPONENTS

MODULE 15 AFQTP UNIT 3

GRADE TRENCHES/PIPELINES (15.3.1.)

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GRADE TRENCHES/PIPELINES

Task Training Guide

STS Reference Number/Title:	15.3.1. Grade trenches/pipelines
Training References:	• Uniform Plumbing Code • AFMANs 32-1070, 88-11 • Uniform Plumbing Code • MOP-11
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Carpenter's level, string, string level, and common hand tools.
Learning Objective:	• The trainee will know the steps required to accurately perform grading of trenches and pipelines. • The trainee will understand theory behind grading of trenches and pipelines.
Samples of Behavior:	• Trainee will complete required steps to grading • trenches and pipelines.
Notes:	
• To successfully complete this element, the steps must be followed exactly--no exceptions • Any safety violation is an automatic failure.	

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GRADE TRENCHES/PIPELINES

Background: Trenches are graded to ensure that wastewater flows through the pipe at the correct velocity. Proper grading of a trench for wastewater pipe installation it is necessary to keep one end of the pipe lower than the other so wastewater will flow freely (gravity flow). Slanting of the sewer pipe is referred to as fall. Slope of the waste pipe should be designed to transport wastewater at a rate the ensures solids are carried with the water through the piping system.. If the flow is too fast, the water flows faster than the solids, which leaves the solids sitting in the pipe to create stoppage. If the water flows to slow, solids settle out and are left in the pipe to create stoppages. For this reason a velocity of two feet per second must be maintained. Velocities greater than ten feet per second can cause solids to separate from the wastewater, creating stoppages, causing excessive turbulence at manholes and eventually eroding the sewer line. Building sewers that are three inches in diameter must have a fall of not less than $^1/_4$ inch per foot. Sewers larger than 3 inch in diameter must have a fall of not less than $^1/_8$ inch per foot. Establishing a grade line and then digging the trench to exactly this line ensures the proper fall. The well-established methods to grade a trench are as follows:

- Surveying with engineers' transit or a fixed-beam laser.
- String line and line level.
- Checking the fall with Carpenter's level

SAFETY:
PRIOR TO ANY EXCAVATION YOU MUST OBTAIN CLEARANCE TO PREVENT INJURY, OR DAMAGE TO ANY UNDERGROUND UTILITIES. USE AF FORM 103 *BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST* TO OBTAIN CLEARANCE

SAFETY:
BRACE AND SHORE OR STEP-OUT THE SIDES OF EXCAVATIONS IN STABLE SOIL 5-FEET OR MORE IN DEPTH, OR IN LOOSE SOIL 4-FEET OR MORE. IN TRENCHES 4-FEET OR MORE IN DEPTH, PROVIDE ACCESS LADDERS THAT EXTEND AT LEAST 3-FEET ABOVE THE TRENCH SIDES AND NO MORE THAN 25 FEET APART.

Fixed Beam Laser or Engineer's Transit. The best method used to grade a trench is surveying with engineers' transit or fixed beam laser. This method is more appropriate for larger projects, such as a long sewer main installation. An Engineering Journeyman will have to assist you when these methods are used. You provide the information on how much slope is required, and then the transit or fixed laser beam is used to shoot the correct grade. These methods are more appropriate for large projects, such as long sewer main installations. See Figure 1

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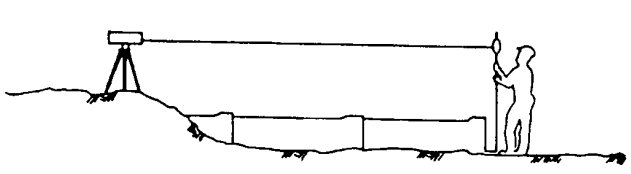


OVER-THE-TOP

A SEWER LASER CAN BE SET UP ON A TRIPOD OR A THREE-POINT TRIVET PLATE IN THE EXCAVATION, ABOVE IT OR ON THE PIPE. THE LASER TARGET IS MOUNTED ON A POLE AND ADJUSTED TO GIVE THE DISTANCE FROM THE BEAM TO THE PIPE INVERT. A LEVEL VIAL ON THE POLE INDICATES A VERTICAL POSITION.

OPEN EXCAVATION

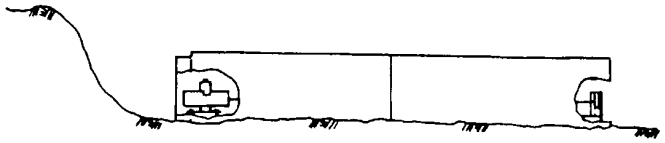
THE VERSATILITY AND FLEXIBILITY OF A SEWER LASER PERMITS A VARIETY OF OPEN EXCAVATION SET-UPS WITH THE BEAM PROJECTED DOWN THE CENTER LINE OF THE PIPE OR OVER-THE-TOP.

IN THE MANHOLE

A SEWER LASER CAN BE SET UP IN A MANHOLE UTILIZING A TRANSIT TO SET THE SEWER LINE ACCURATELY. THE TRANSIT IS PLUMBED OVER THE LASER ON A MOUNT THAT CLAMPS TO THE MANHOLE EDGE. THE LASER BEAM IS PROJECTED ALONG THE PIPE CENTER LINE.

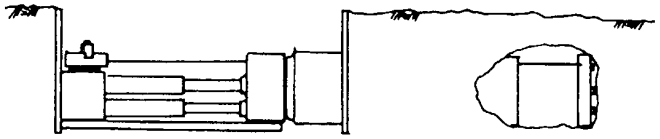
IN SMALL PIPE

SOME SEWER LASERS CAN BE SET DIRECTLY INSIDE IN PIPES AS SMALL AS 6 INCHES IN DIAMETER. THIS ALLOWS FAST SET UPS THE SECOND DAY AS WELL AS THE VERSATILITY TO MEET SITUATIONS IN WHICH THE LASER CANNOT BE SET UP IN A MANHOLE.



IN LARGE PIPE

FOR LARGE PIPE, A LASER CAN BE SET UP DIRECTLY ON THE INVERT OF THE PIPE USING THE THREE-POINT TRIVET PLATE.



PIPE JACKING

ELECTRONIC SELF-LEVELING SEWER LASERS CAN ALSO BE USED TO PROVIDE LINE AND GRADE CONTROL IN PIPE JACKING OPERATIONS. THE LASER IS SET UP IN THE JACKING PIT AND THE TARGET IS MOUNTED ON THE CUTTING SHIELD.

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Figure 1, Fixed Beam Laser Used to Grade Trenches/Pipelines

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String Level. The String level method is commonly used because it is a relatively quick, simple, and inexpensive way to check for proper grade. The process involves stretching and leveling a string between stakes positioned along a trench. The discharge end is then lowered to the amount of grade required. For example, if the distance between the stakes is 50 feet, and the grade wanted is $^1/_4$ inch per foot, drop the lower end of the string $12^1/_2$ inches ($^1/_4$ inch x 50 = $12^1/_2$ inches). A tape measure or a grade stick (made of lumber, possibly 1 x 2 inches) that is marked with desired trench depth may be used to take random depth readings of trench. Compare measurements or the mark on the grade stick to the string along the trench to obtain the proper slope. See Figure 2.

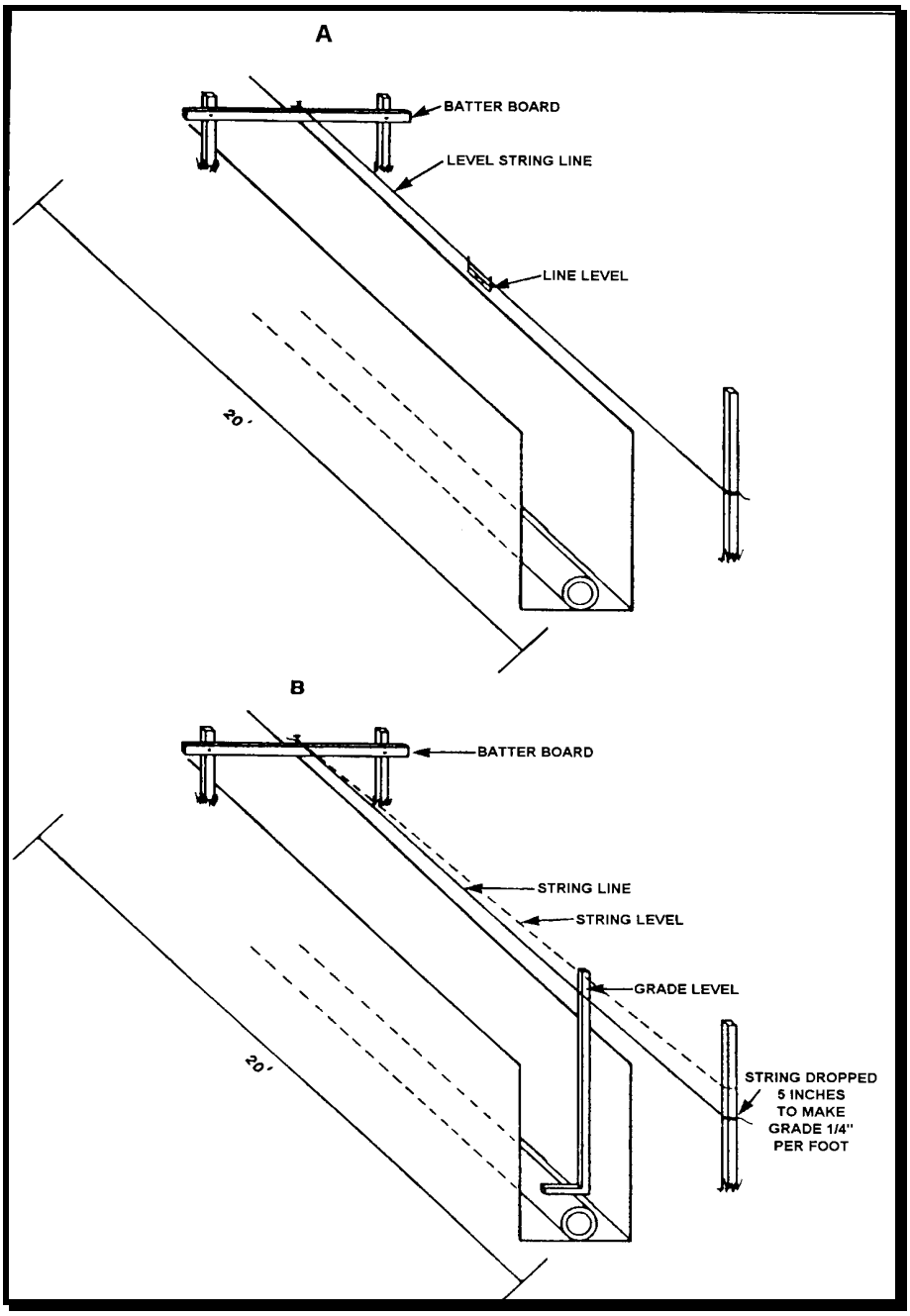

Figure 2. Using a String Level to Grade Trenches

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

To perform this task, follow these steps:

Step 1: Drive stakes on each end of trench.

Step 2: Attach the string to both stakes and check level.

- Be sure to leave enough room between the line and the ground so that discharge end of the string can be lowered to the proper height.

Step 3: Measure the distance of the string between the two stakes, then multiply that distance by the proper pipe slope.

- For example, if the distance between the stakes is 50 feet, and the grade wanted is $^1/_4$ inch per foot, drop the lower end of the string $12^1/_2$ inches ($^1/_4$ inch x 50 = $12^1/_2$ inches).

NOTE:
Make every effort to prevent the string from moving out of position once it has been established.

Step 4: Mark the location of the leveled string on the stakes at each end of the trench.

- Next mark the outlet end stake with the distance that was obtained on previous step. For example, if the distance was $12^1/_2$ inches, place a mark $12^1/_2$ inches below the level mark on the outlet stake.

Step 5: Determine what the required depth of the trench is and mark it on a grade stick.

NOTE:
The required depth of the trench must be below the frost line.

Step 6: Dig the trench using the grade stick as a standard for the depth.

- This is accomplished by matching the mark on the grade stick (or tape measure if used) with the sloped string along the trench. You will know that the trench is at the proper depth and slope when the grade stick is placed at any point in the trench and the mark always matches the established string slope.

Carpenter's Level. Because of the time consuming nature of this method, it is best used on relatively shorter pipe runs. This method involves placement of the Carpenter's Level on the pipe at the high end; place a block of wood, corresponding in thickness to the grade required, under the low end of the level. When the air bubble is centered between the marks on the level, the pipe has the proper grade. To determine the proper slope of the pipe, the length of the level and the size of the pipe must be considered. See Figure 3.

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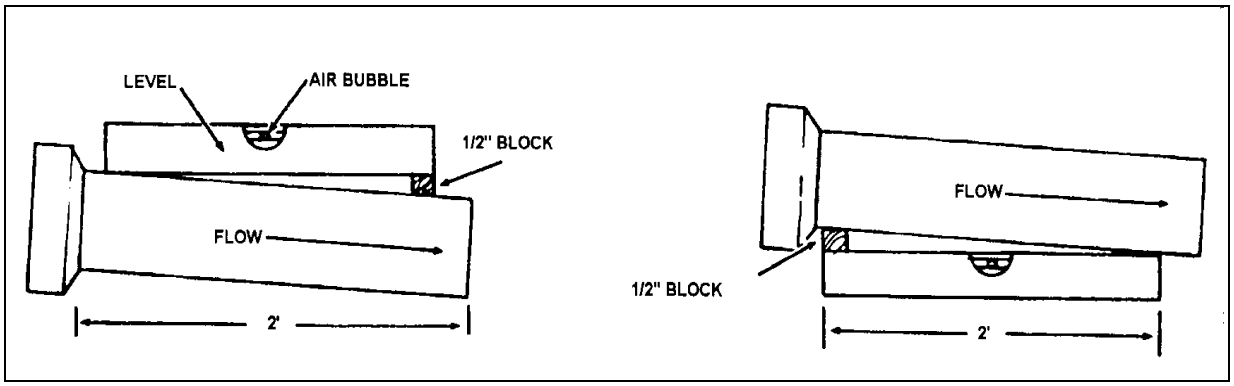

Figure 3, Using a Carpenter's Level to grade Trenches/Pipelines

To perform this task, follow these steps:

Step 1: Start at the drain or inlet side of pipe.

- Smooth the bottom of the trench and lay down the pipe.

NOTE:
If using pipe that has bell and spigot type joints, dig holes beneath each hub so that the pipe lies flat and is supported only on its main body by the trench bed. This prevents stress on the joints.

Step 2: Attach a block of wood (with its thickness corresponding to the desired grade) under the low end of level.

- The block of wood may be secured with a **thin** piece of masking tape (or some other suitable adhesive) that will not significantly change its height. Place the level on the pipe at the high end and adjust the soil under the pipe until the air bubble on the level is centered. For example, if the level is 2 feet long and the pipe is 3 inches in diameter, the proper thickness of the block is 2 feet x 1/4 inch, or $^1/_2$ inch.

NOTE:
This leveling procedure is done at random points along the pipeline.

Trench Bedding. Selection of the proper bedding material, class of bedding for the pipe to be laid, and the compaction of bedding are all important factors in maintaining proper grade and slope. A major consideration before selecting trench bedding should be the peak pressures and velocities. Any pipe laid in a trench must have the proper foundation beneath it and surrounding it to maintain proper grade, and to prevent crushing of the pipe. This is why material selection; class of bedding, and compaction are so important. There are five classes of bedding construction (See Figure 4). Class A-1 is the strongest bedding construction available because of the materials used for this classification—concrete, or clay bricks. Class A-1 bedding is harder to construct when pipe diameter is small, because the pipe tends to "float" or shift in the concrete. Class D bedding is the weakest bedding, because the pipe is supported by the bottom of the trench and back fill. Materials such as ¼ to ¾-inch crushed rock is most commonly used to construct the class B and C bedding. Sand and pea gravel also fall into this category. Crushed rock is preferred over sand and pea gravel because it does not require compaction. When it is not practical to

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import granular materials to the job site, use native soils (the trench's excavated material) in the bottom of trench to construct a class C bedding.

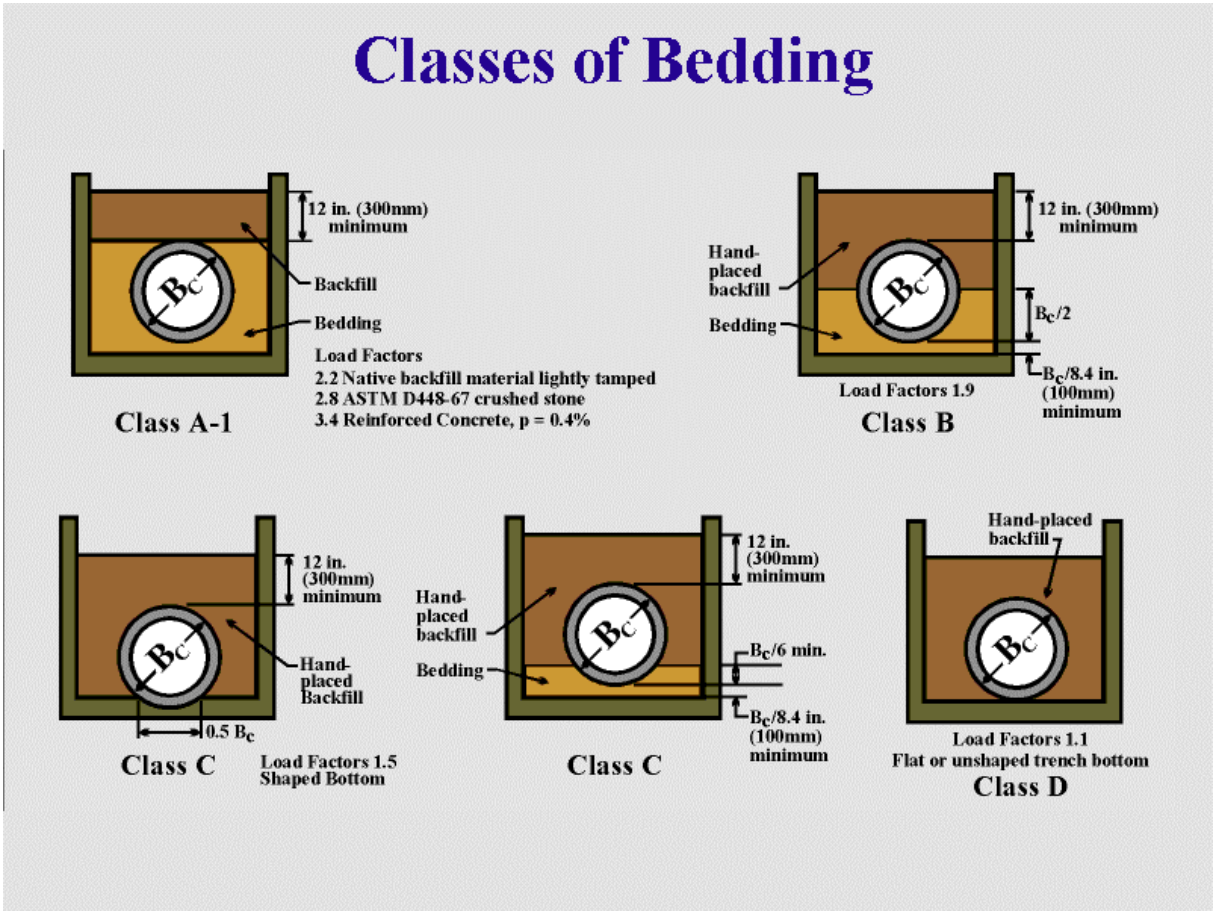

Figure 4. Classes of Bedding

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Review Questions
for
Grade Trenches/Pipelines

Question	Answer
1. Why are trenches graded?	a. So waste flows through the pipe at the correct velocity b. So solid in wastewater will settle c. So the trench will drain properly d. So the pipe is not crushed
2. Sewers larger than 3 inches in diameter must have a fall of not less than _____.	a. $^1/_4$ inch per foot b. $^1/_8$ inch per foot c. $^1/_2$ inch per foot d. $^3/_4$ inch per foot
3. What form is used to obtain clearance prior to digging?	a. AF Form 103 b. AF Form 1103 c. AF Form 301 d. AF Form 130
4. How far apart should access ladders be placed in a trench?	a. 25 feet b. 35 feet c. 45 feet d. 50 feet
5. What method of grading trenches is more appropriate for large projects?	a. String level b. Carpenter's level c. Tape measure d. Fixed beam laser
6. Using the string level method determine how much fall is required if the distance between the stakes is 50 feet, and pipe diameter is 3 inches.	a. 10 inches b. $11^1/_2$ inches c. $12^1/_2$ inches d. $12^1/_2$ feet
7. What method of grading trenches/pipelines should be used as a last resort?	a. Engineers' transit b. Carpenter's level c. Fixed beam laser d. String level
8. Which class of bedding construction uses concrete?	a. Class A-1 b. Class B-1 c. Class C-1 a. Class D-1
9. What material is most commonly used to construct class B and C bedding?	a. $^1/_4$ to $^3/_4$ inch crushed rock b. Native soil c. Concrete b. Mud

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GRADE TRENCHES/PIPELINES

Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify methods to grade a trench? • Surveying with engineers' transit or a fixed-beam laser. • String line and line level. • Checking the fall with Carpenter's level		
2. Did the trainee take proper safety precautions? • Obtained an approved AF Form 103. • Shored /stepped-out trench • Provided Access ladder		
3. Did the trainee complete steps of grading trenches and pipelines using the string line and line level? • Drove stakes on each end of trench. • Attached the string to both stakes and check with string level. • Measured the distance of the string between the two stakes, then multiplied that distance by the proper pipe slope. • Marked the location of the leveled string on the stakes at each end of the trench. • Determined what the required depth of the trench is and marked it on a grade stick. • Excavated trench using the grade stick as standard for the depth.		
4. Did the trainee complete steps of grading trenches and pipelines using the Carpenter's level? • Started at the drain or inlet side of pipe. • Attached a block of wood (with its thickness corresponding to the desired grade) under the low end of level. • Randomly check point on pipeline for proper grade.		
5. Did the trainee understand the theory of the five classes of bedding? • Class A-1 • Class B • Class C-1 • Class C		
6. Did the trainee complete all the questions in QTP? • Score 80% or higher. • Did trainer review and explained all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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MAINTAIN WASTEWATER SYSTEMS

MODULE 15 **AFQTP UNIT 5**

PLUNGERS (15.5.1.1.1.)

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PLUNGERS

Task Training Guide

STS Reference Number/Title:	15.5.1.1.1., Plungers
Training References:	• 3E451 CDC's • Study Guide/ Work Book J3ABR3E431 003/004/005
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Vacuum Plunger • Force Cup Plunger
Learning Objective:	• Trainee should understand usage of utilize vacuum and force cup plunger.
Samples of Behavior:	• Trainee will successfully open clogged or restricted drainage system using vacuum plunger and force cup
Notes:	
• Ensure no chemicals were used to unclog restricted drain-chemicals may splash on personnel.	

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PLUNGERS

Background: One of the most common calls for a plumber is to clear a clogged drain. Several options may be considered to perform this familiar task (Chemical: sulfuric acid, muratic acid, or caustic soda, Biological: enzymes, or Mechanical: augers, metal tapes, and plungers). When the plunger method is considered, there are two types that may be used the vacuum and force cup plungers. Let's discuss each type and their primary usage.

- **Vacuum plungers.** When a sink, lavatory, or similar flat-surface drain is stopped up completely, a mechanical method may be used to remove the obstruction. The vacuum plunger consists of a rubber suction cup (about 5-inches in diameter) fastened to a wooden handle. (Figure 1)

- **Force Cup Plungers.** A force cup plunger is similar to a vacuum plunger; however, the major difference is where the instrument will be used. Force cups are designed with a more spherical cup and a smaller opening. This design is more suited for water closet bowls and wall-hung urinals that have integral traps with curved openings. (Figure 2).

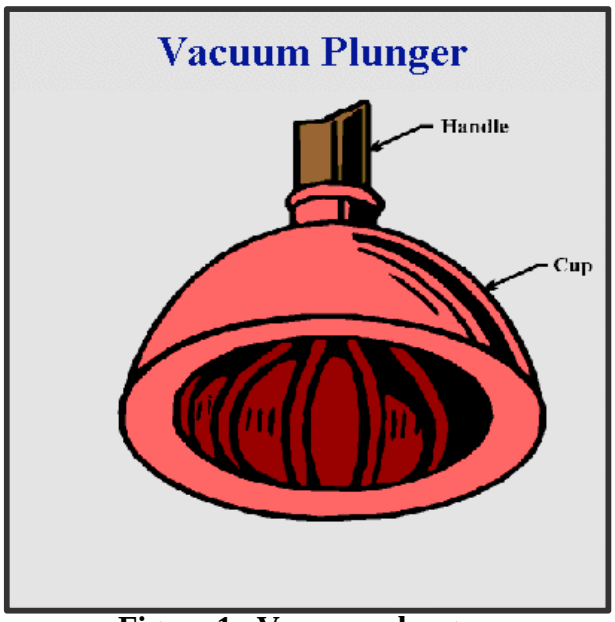

Figure 1. Vacuum plunger

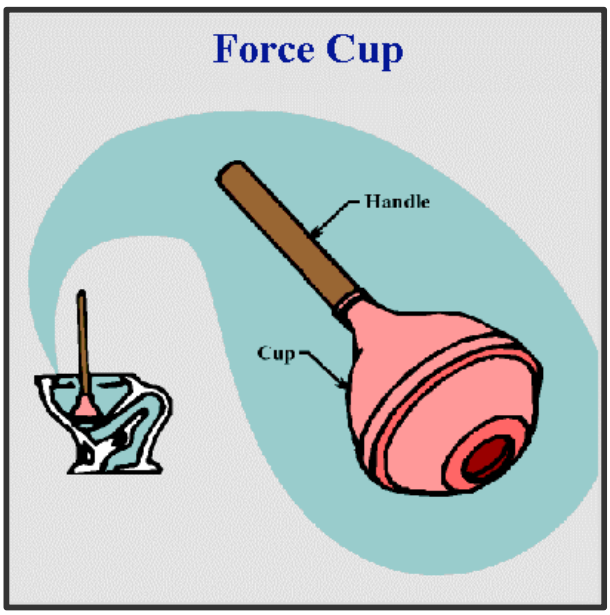

Figure 2. Force Cup

To perform tasks using vacuum plungers, follow these steps:

Step 1: Cover the entire drain opening with the plunger's cup.

Step 2: Seal all vents and overflow openings.

Step 3: Apply an upward and downward motion to the plunger handle without lifting the cup from the drain's surface.

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Step 4: Continue this motion until maximum suction is achieved (you'll recognize this by a heavy vacuum on the drain side of the cup).

Step 5: Once you feel a heavy suction on the plunger, hold the handle firmly (making sure that your face is not directly over the handle), and make a swift (but controlled) upward pull. If you were successful, you'll notice the standing water draining rapidly. If this doesn't happen, then continue with step "7".

Step 6: Repeat steps 1- 5 until the drain does drain rapidly.

Step 7: Refill or flush the fixtures to verify a smooth flow of the drain.

Step 8: If after several attempts you are not able to unclog the drain, an alternate method must be used.

SAFETY:
ALWAYS ENSURE THAT ACID HAS NOT BEEN POURED INTO THE DRAIN BEFORE PLUNGING. IF ACID HAS BEEN POURED INTO THE DRAIN REMOVE, FLUSH, AND REFILL WITH FRESH WATER. BE SURE TO WEAR PROPER SAFETY EQUIPMENT.

To perform tasks using force cup plungers, follow these steps:

Step 1: Insert force cup plunger into the outlet of the fixture.

Step 2: Ensure fixture is filled with water as near the top of the rim as possible.

Step 3: Alternate pushing and pulling strokes of the handle.

Step 4: Continue this motion until you have worked the obstruction loose.

Step 5: Repeat steps 1- 4 until the obstruction has been removed.

Step 7: Refill and flush the fixtures to verify a smooth flow of the drain.

Step 8: If after several attempts you are not able to unclog the drain, an alternate method must be used.

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Review Questions for Plungers

Question	Answer
1. What are the two types of plungers?	a. Vacuum plunger and force cup plunger b. Vacuum plunger and jet cup plunger c. Force jet plunger and force cup plunger d. Vacuum jet plunger and force jet plunger
2. The vacuum plunger is used for what type of restricted drain?	a. Lavatories b. Sinks c. Flat surface drains d. All of the above
3. Water closets or urinals with integral traps are best cleared with a _____.	a. Vacuum plunger b. Jet cup plunger c. Force cup plunger d. Vacuum jet plunger
4. When should you **NOT** use a plunger on a restricted drain?	a. Before chemical usage b. After chemical usage c. Before biological usage d. After biological usage

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PLUNGERS

Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify the two types of plungers? • Vacuum • Force Cup		
2. Did the trainee follow step-by-step procedures for using a vacuum plunger? • Covered the entire drain opening with the plunger's cup. • Sealed all vents and overflow openings. • Applied an upward and downward motion without lifting the cup from the drain's surface. • Continued this motion until maximum suction is achieved • Once they felt a heavy suction on the plunger, they held the handle firmly (making sure that your face is not directly over the handle), and made a swift (but controlled) upward pull. If they were successful, they notice the standing water draining rapidly. • Repeat steps 1- 5 until the drain does drain rapidly (if necessary). • Refilled or flushed fixtures to verify a smooth flow of the drain. • Determined after several attempts to use an alternate method (if necessary).		
3. Did the trainee follow step-by-step procedures for using a force cup plunger? • Inserted force cup plunger into the outlet of the fixture. • Ensured fixture is filled near the top of the rim as possible. • Alternated pushing and pulling strokes of the handle. • Continued this motion until the obstruction worked loose. • Repeated steps 1- 4 until the obstruction has been removed (as needed). • Refilled and flushed the fixtures to verify a smooth flow. • If after several attempts you are not able to unclog the drain, an alternate method must be used (if necessary).		
4. Did the trainee take proper safety precautions? • Ensure that acid had not been poured into the drain before plunging.		
5. Did the trainee complete all the questions in the QTP? • Score 80% or higher. • Did trainer review and explained all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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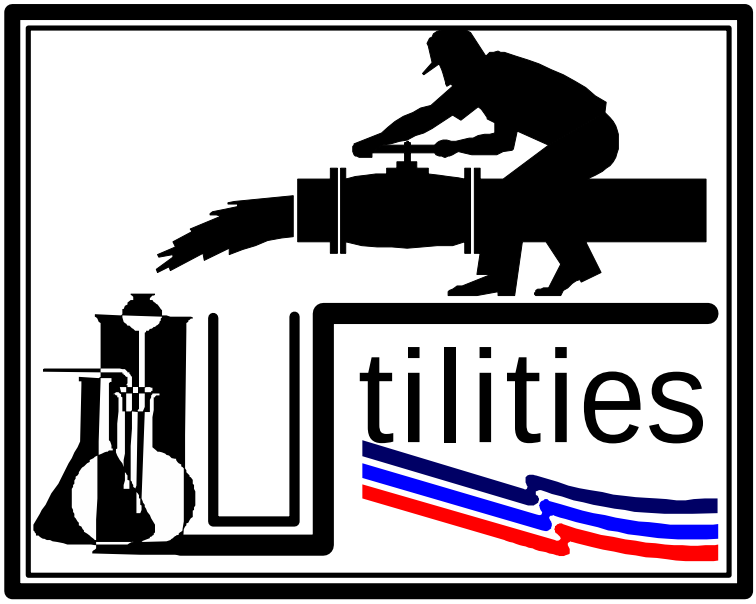

MAINTAIN WASTEWATER SYSTEMS

MODULE 15 **AFQTP UNIT 5**

POWER AUGERS (15.5.2.1.1.)

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POWER AUGERS

Task Training Guide

STS Reference Number/Title:	15.5.2.1.1., Power Augers
Training References:	• CDC 3E451 • Manufacturers' Manuals
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• POWER AUGER • WORKING GLOVES • GOGGLES
Learning Objective:	• Trainee will understand the operating procedures of a power auger.
Samples of Behavior:	• Trainee will properly unclog restrictions using the power auger.
Notes:	
• Any safety violation is an automatic failure.	

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POWER AUGERS

Background: The purpose of using power augers is to open exterior or relatively larger wastewater drain systems. There are many types of augers available to you as a Utilities Systems Journeyman. One type that you will often use in the field will be a power auger, used to unstop large waste lines. Each manufacturer will have specific guidelines on how to use their augers; however, here are some general steps for a basic power auger:

SAFETY:
YOU SHOULD ALWAYS USE GLOVES WHEN OPERATING A POWER AUGER. CHECK ELETRICAL CORD FOR DAMAGE BEFORE PLUGGING AUGER INTO AN OUTLET. REMOVE ALL JEWELRY BEFORE OPERATING POWER AUGER. WATCH FOR EXCESS SLACK IN CABLE WHILE OPERATING AUGER.

To clear wastewater drains using augers, follow these steps:

Step 1: Gather required equipment (power auger, goggles gloves and steel toe boots).

Step 2: Plug auger into approved power source (Check the cord and plug for damages).

Step 3: Loosen cable release.

Step 4: Remove cable from auger.

Step 5: Insert cable from auger into the opening of clogged or restricted drain.

Step 6: Tighten the automatic feed on auger. The automatic feed is used to feed and reverse the cable.

Step 7: Step on foot pedal and move feed lever to the forward position to allow auger cable to feed to open restriction.

Step 7: Once drain becomes free of the obstruction, put feed lever into the neutral position, then remove your foot from the pedal. Allow the auger to come to a complete stop

Step 8: Move the feed lever to reverse position.

Step 9: Step on the foot pedal, this will retract cable from drain line.

Step 10: Flush line with water to ensure drain is free of obstruction.

Step 11: Cleanup work area and store equipment.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

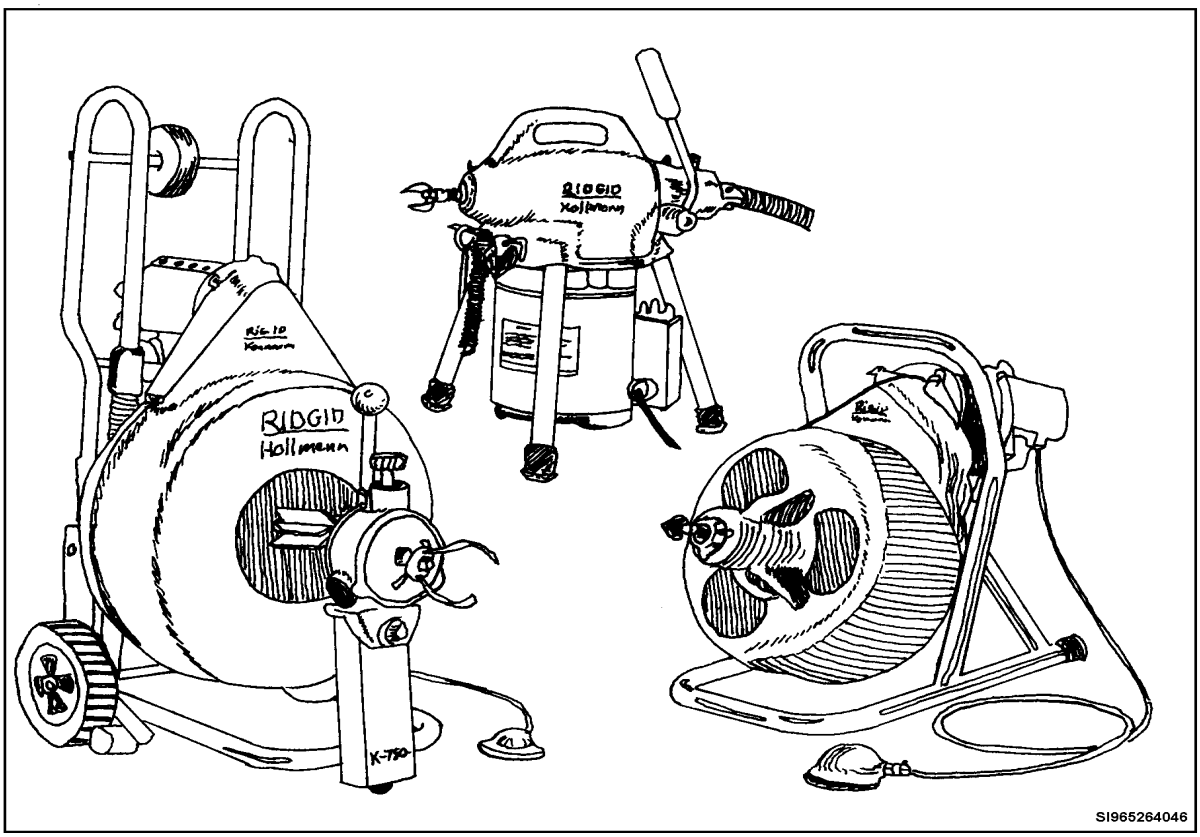

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Figure 1, Types of Power Augers

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

Review Questions
for
Power Augers

Question	Answer
1. Power augers are used on what kind of clogged lines?	a. Large water lines b. Exterior waste lines c. Large water lines d. Small waste lines
2. What is the feed lever used for?	a. To automatically feed the cable b. To manually feed the cable c. To automatically feed and reverse the cable d. None of the above
3. Before feeding the cable what must you do first?	a. Tighten down automatic feed knob on auger b. Tighten down manual feed knob on auger c. Loosen the automatic feed knob on auger d. Loosen the manual feed knob on auger
4. Why do you want to keep excess cable to a minimum?	a. It may damage the cable and/or cause it to kink b. Augers work better with a short cable c. Excess cable extraction will prolong the augers life d. None of the above

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POWER AUGERS

Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify the usage for a power auger? • Unstop large waste lines		
2. Did the trainee take proper safety precautions? • Used gloves while operating power auger. • Checked electrical cord for damage. • Removed all jewelry before operating power auger. • Watched for excess cable while operating power auger.		
3. Did the trainee know how to properly operate power auger and open clogged line? • Gathered required equipment (power auger, goggles gloves and steel toe boots). • Plugged auger into approved power source. • Loosened cable release. • Inserted cable from auger into the drain. • Started power auger by depression the foot pump. Applied minimum force to feed cable. Avoided excessive force that would have damaged the cable and/or cause it to kink. • Stopped power auger once the obstruction was cleared. Ensured drain was clear, removed cable and stored away properly. • Flushed line with water to ensured drain is free of obstruction. • Cleaned-up work area and stored equipment**.**		
4. Did the trainee complete all the questions in the QTP? • Score 80% or higher. • Did trainer review and explained all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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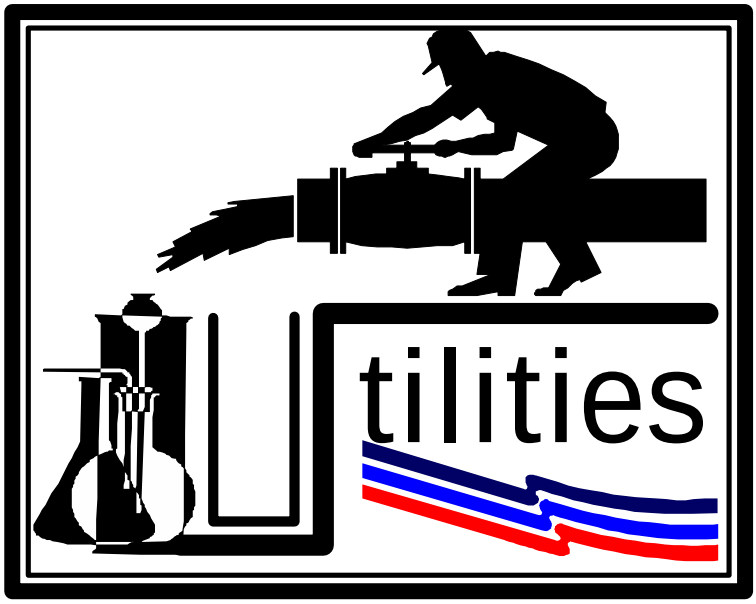

MAINTAIN WASTEWATER SYSTEMS

MODULE 15 **AFQTP UNIT 5**

SEWER AUGERS (15.5.2.1.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SEWER AUGERS

Task Training Guide

STS Reference Number/Title:	15.5.2.1.2., Sewer Augers
Training References:	• CDC 3E451 • Study Guide/Workbook J3ABR3E431 003/004/005 • Manufacturers' Manuals
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Sewer Auger, Gloves, Goggles, Steel-toed Boots
Learning Objective:	• Trainee will understand how to safely open a clogged drainage system using a sewer auger.
Samples of Behavior:	• Trainee will be able to open a clogged drain system using a sewer auger.
Notes:	
• Any safety violation is an automatic failure.	

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SEWER AUGERS

Background: The primary causes of a stoppage in exterior sewer lines are tree roots and/or grease. Other factors causing a stoppage may include poor construction, age, external pressure or corrosion. Sewer auger's main components are an engine, drive unit, a bundle of sectional or continuous coil cable. An average auger will be most effective in lines up to 12" in diameter. Procedures for clearing drains with sewer augers are very similar to power augers. As always, consult your manufacturer's manuals for specific operation. Below are steps for unstopping blockages with a basic sewer auger:

SAFETY:
- **REMOVE ALL JEWELRY AND LOOSE CLOTHING BEFORE BEGINNING PROCEDURES.**
- **HAVE A MINIMUM OF TWO PERSONNEL OPERATING EQUIPMENT.**

To clear wastewater drains using augers, follow these steps:

Step 1: Gather required equipment (auger, goggles, gloves, and steel toe boots)

HINT:
Before gathering equipment, review confined space entry procedures and begin testing and venting the manhole (hazardous gasses may exist).

Step 2: Perform pre-operational checks.
Check; oil level, battery connections, water levels, hydraulic fluid level, and belt tightness. Also, check the cable or rods for rust, damage, or breaks.

Step 3: Position machine near manhole.
You should enter the sewer system at a clear manhole downstream from the obstruction. Position the machine two to three feet from the opening of the manhole.

Step 4: Place correct head on cable (based on the suspected cause of blockage).

Step 5: Insert cable into system.
When placing the cable into the sewer system, use a J-tube to direct the cable into the sewer line. Be sure to feed the cable upstream toward the obstruction.

Step 6: Start engine.
After the unit has started allow it to run for a couple of minutes to warm the engine. After the engine is warm test the unit for proper operation.

Step 7: Test unit operation.
This may save you the trouble of pulling a lot of cable out by hand. Test the inward movement, retrieval movement, and the rotating orturning movement.

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Step 8: Slowly feed cable to the restriction.
The purpose for the slow feed is when you hit the stoppage the cable may bind damaging the cable, cable head, or the machine itself.

Step 9: Once the cable has cleared the restriction, remove the cable.
After the cable has been removed from the manhole the sewer system needs to be flushed for a few minutes.

NOTE:
The cable is extracted in the same direction of rotation as when it was inserted. This prevents the blockage from being dislodged from the head of the auger.

Step 10: Clean the cable and sewer machine.
The cable must be cleaned and oiled to prevent corrosion of the cable.

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Review Questions
for
Sewer Augers

Question	Answer
1. What is the first and most important action before operating the sewer auger?	a. Notify people in the vicinity b. Review confined space entry procedures c. Review lock-out-tag-out procedures d. None of the above
2. Sewer augers are effective in lines up to _____ in diameter.	a. 10” b. 12” c. 14” d. 16”
3. Augers may come in various types and sizes from 350 ft. to 1200 ft	a. True b. False

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SEWER AUGERS

Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify all the equipment needed for the job? • Auger • Goggles • Gloves • Steel toe boots		
2. Did the trainee take proper safety precautions? • Removed all jewelry and loose clothing. • Had a minimum of two personnel operating equipment.		
3. Did the trainee complete step-by-step procedure • Gathered required equipment. • Reviewed confined space entry procedures. • Performed pre-operational checks. • Positioned machine near manhole. • Placed correct head on cable. • Inserted cable into system. • Started engine. • Tested unit operation. • Slowly feed cable to the restriction. • Remove the cable. • Cleaned the cable and sewer machine.		
4. Did the trainee complete all the questions in the QTP? • Score 80% or higher. • Did trainer review and explained all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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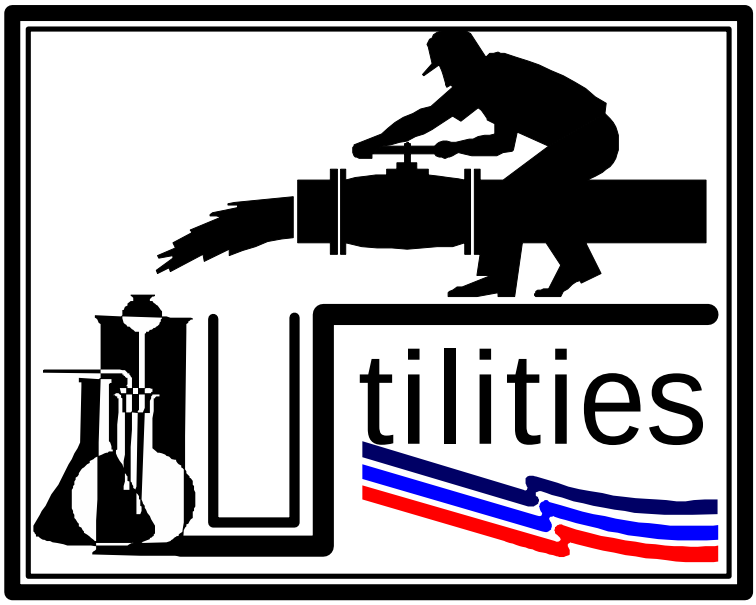

REPAIR OF WASTEWATER SYSTEMS COMPONENTS

MODULE 15 **AFQTP UNIT 6**

INTERIOR WASTEWATER SYSTEMS (15.6.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

INTERIOR WASTEWATER SYSTEMS

Task Training Guide

STS Reference Number/Title:	15.6.1., Interior Wastewater Systems
Training References:	• 3E451 CDC's • Study Guide/Workbook J3ABR3E431
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Proper tools, pipe and joint fittings.
Learning Objective:	• Trainee will understand the procedures for repairing interior wastewater systems.
Samples of Behavior:	• Trainee will be able to properly repair interior wastewater systems.
Notes:	
• Any safety violation is an automatic failure.	

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INTERIOR WASTEWATER SYSTEMS

Background: Maintenance of interior wastewater systems is important. If a drainage system has a leak or crack, it will need to be repaired right away. Leaks or cracks in an interior drainage system could not only cause damage to the building, but it could also create a health hazard.

Repairs on an interior drainage system will be different depending on the type of piping and the types of joints used. There are two types of pipe primarily used on interior wastewater systems: Cast iron soil pipe (C.I.S.P.) and plastic (PVC) pipe.

Assembling Compression Joint. This type of joint uses a bell and spigot. It is sealed with a neoprene rubber gasket. When the spigot end of the pipe end of the pipe and the neoprene gasket are lubricated and pushed or drawn into the gasket hub, the joint is sealed by displacement and compression of the rubber gasket.

Assembling No Hub Joints. These types of joints use a one-piece neoprene gasket and a stainless steel shield and retaining clamps. The advantage of this type of joints is: it permits joints to be made in confined spaces, it's fast, and few tools are required. The disadvantage is extra hangers are required.

SAFETY:
CAST IRON SOIL PIPE IS HEAVY SO YOU WILL NEED ASSISTANCE ON REPAIRS. THE DANGERS INVOLVED WITH PLASTIC PIPE ARE THE FUMES FROM SOLVENT WELDING CEMENT AND THE CLEANER COMPOUNDS. KEEP THE WORK AREA WELL VENTILATED AND FREE OF POTENTIAL IGNITION SOURCES.

HINT:
Plastic pipe and no hub joints can be used to substitute for a section of C.I.S.P. for repairs.

To perform this task, follow these steps:

Step 1: Gather required equipment and material.

Step 2: Locate damaged pipe using building plans and location devices (if necessary).

Step 3: Isolate upstream flow of sewage by using a valve, pump, pneumatic plug, mechanical plug or other means available.

Step 4: Clean surface area of pipe to be cut.

HINT:
Do not cut too close to the joint. This will not leave enough room to correctly install joint fitting.

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Step 5: Cut damaged section of pipe from system.

Step 6: Measure the amount of pipe needed to replace the damaged pipe.

Step 7: Cut the length of pipe needed to replace the damaged pipe.

NOTE:
If cutting cast-iron soil pipe, a snap cutter will be needed. If cutting plastic pipe, a saw is needed.

Step 8: Install new section of pipe and joint fittings.

Step 9: Clean area and equipment and remove damaged piping.

Step 10: Remove plugs or open valves to resume flow.

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Review Questions
for
Interior Wastewater Systems

Question	Answer
1. What equipment is used, when cutting cast iron soil pipe?	a. Table saw b. Chisel cutter c. File cutter d. Chain snap cutter
2. What are the primary types of pipe used for interior wastewater systems?	a. Copper and plastic b. Copper and black iron c. Cast iron and black iron d. Cast iron soil pipe and plastic pipe.
3. _____ can be used to substitute for cast iron pipe.	a. Copper b. Plastic c. Brass d. Black iron
4. Safety precautions are **NOT** a major concern when installing interior wastewater piping	a. True b. False

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

INTERIOR WASTEWATER SYSTEMS

Performance Checklist		
Step	**Yes**	**No**
1. Did the trainee follow step for repair interior wastewater system properly? • Gathered required equipment and material. • Located damaged pipe using building plans and location devices (if necessary). • Isolated upstream flow of sewage. • Cleaned surface area of pipe to be cut. • Cut damaged section of pipe from system. • Measured for new pipe needed to replace the damaged pipe. • Cut the length of pipe needed to replace the damaged pipe. • Installed new section of pipe and joint fittings. • Cleaned area and equipment and remove damaged piping. • Removed plugs or open valves to resume flow.		
2. Did the trainee complete all questions in the QTP? • Score 80% or higher. • Did trainer review and explained all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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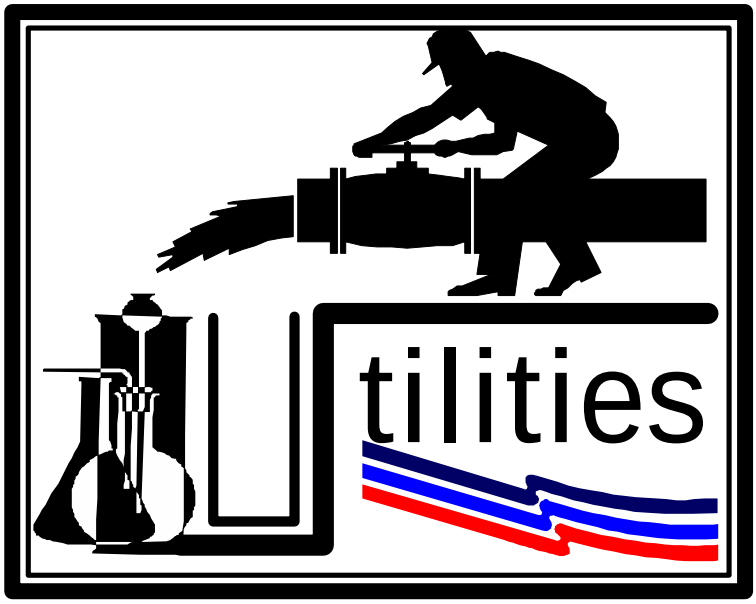

REPAIR OF WASTEWATER SYSTEMS COMPONENTS

MODULE 15 **AFQTP UNIT 6**

EXTERIOR WASTEWATER SYSTEMS (15.6.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

EXTERIOR WASTEWATER SYSTEMS

Task Training Guide

STS Reference Number/Title:	15.6.2., Exterior Wastewater Systems
Training References:	• 3E451 CDC's • Study Guide/Workbook J3ABR3E431
Prerequisites:	• Possess as a minimum a 3E431 AFSC
Equipment/Tools Required:	• Rubber Boots, Gloves • Clamps
Learning Objective:	• Individual should be able to make temporary and permanent repairs.
Samples of Behavior:	• Trainee will be able to successfully and safely repair an exterior wastewater system without error.
Notes:	
• Any safety violation is an automatic failure.	

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EXTERIOR WASTEWATER SYSTEMS

Background: Wastewater piping conveys waste to and from the components of the wastewater system. These components begin from the building sewer and generally terminate at the wastewater treatment plant. Every effort should be made during installation and repairs to reduce the probability of leaks and ruptures. If leaks or breaks are found, temporary and permanent repairs have to be made to reduce the risk of health hazards, objectionable odors and sub-grade erosion.

SAFETY:
SEWER GASES ARE EXPLOSIVE. IF YOU MUST ENTER A MANHOLE, VENTILATE IT FIRST. USE THE BUDDY SYSTEM. IF YOUR BUDDY BECOMES UNCONSCIOUS DO NOT GO IN MANHOLE AFTER HIM, CALL FOR HELP. WEAR GLOVES AND RUBBER BOOTS TO KEEP WASTE AWAY FROM CONTACTING YOUR SKIN.

HINT:
Before gathering equipment, review confined space entry procedures and begin testing and venting the manhole if applicable (hazardous gasses may exist).

To perform temporary repairs, follow these steps:

Step 1: Gather tools and supplies.
- (Pumps, wrenches, bucket, rags, etc.) and parts (repair clamps, couplings, pipe sections, etc.) for the kind of repair to be made.

Step 2: Ensure that pipe surface around crack or break is free of dirt and debris.

Step 3: Place the clamp around the pipe.
- The damaged area should be centered on the inside of the clamp. If the length of the damaged area is longer than the clamp (especially in the case of cracks and multiple ruptures), a section of the pipe will need to be cut out and replaced (i.e., perform a permanent repair).

Step 4: Place bolts through the appropriate slots on the clamp.

Step 5: Oscillate clamp until rubber gasket is flat onto pipe surface (avoid kinks in the gasket).

Step 6: Tighten clamp bolts evenly, starting with the middle bolt and work to the outer bolts.

Step 7: Once the bolts are tight, resume the flow and check the clamp for leaks.

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NOTE:
Make sure you do not over tighten bolts, clamp may break or crush the pipe. The clamp is removed when a permanent repair can be made.

To perform permanent repairs, follow these steps:

Step 1: Gather necessary parts, tools and materials.

NOTE:
Compression couplings, mechanical joints, solvent weld joints, rubber seals, full circle clamps or a combination thereof could be used.

Step 2: Stop the flow of waste to the area by plugging the outlet of the nearest upstream manhole.

Step 3: Cut the piping (the method of cutting is determined by the piping material).

Step 4: Remove and measure the bad section of pipe you just cut out.

Step 5: With "step 4" measurement, measure and cut a replacement pipe (ensure outer diameters of the old and new sections are compatible with clamps).

Step 6: Using two repair clamps and the new section of pipe, install them between two cut section.

NOTE:
Compression couplings, mechanical joints, solvent weld joints, rubber seals, full circle clamps or a combination could be used. The piping material of the original pipe determines the type of repair clamp.

Step 7: Unplug manhole and allow wastewater to flow, check for leaks.

Step 8: Test for leaks then backfill.

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Review Questions
for
Exterior Wastewater Systems

Question	Answer
1. What two kinds of exterior repairs are there?	a. New and old b. Temporary and permanent c. Horizontal and vertical d. Parallel and perpendicular
2. Before installing the clamp on a temporary repair what must you do first?	a. Ensure pipe opening cut with a slant b. Ensure pipe opening is free of dirt and debris c. Ensure pipe surface is free of dirt and debris d. None of the above
3. What bolt must you tighten first?	a. Middle and work towards the outer bolts b. Outer, then work towards the middle c. It doesn't matter which you tighten first
4. Before you can replace defective sewer pipe what must you do first?	a. Plug outlet of the nearest downstream manhole b. Plug outlet of the nearest upstream manhole c. Plug outlet of the furthest downstream manhole d. Plug outlet of the furthest upstream manhole
5. What determines the method of cutting the pipe?	a. The piping length b. The piping material c. The piping outer diameter d. The piping inner diameter
6. What determines which repair method you use?	a. The piping size b. The depth of the pipe c. The extent of the damage d. The piping material being used

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EXTERIOR WASTEWATER SYSTEMS

Performance Checklist		
Step	**Yes**	**No**
1. Did the trainee take proper safety precautions? • Ventilated manhole (if needed). • Used the buddy system. • Used gloves • Used rubber boots		
2. Did the trainee know the steps to make a temporary repair to an exterior wastewater system • Gathered tools and supplies. • Ensured pipe surface around crack or break is free of dirt and debris. • Placed bolts through the appropriate slots on the clamp. • Oscillated clamp until rubber gasket is flat onto pipe surface (avoid kinks in the gasket). • Tighten clamp bolts evenly, starting with the middle bolt and work to the outer bolts. • Checked the clamp for leaks.		
3. Did the trainee know the steps to make a permanent repair to an exterior wastewater system? • Gathered necessary parts, tools and materials. • Stop the flow of waste to the area by plugging the outlet of the nearest upstream manhole. • Cut the damaged section of piping • Measured and cut a replacement pipe. • Used two repair clamps for new section of pipe, installed them between two cut section. • Unplug manhole and allowed wastewater to flow, check for leaks. • Test for leaks then backfill**.**		
4. Did the trainee complete all questions in the QTP? • Score 80% or higher. • Did trainer review and explained all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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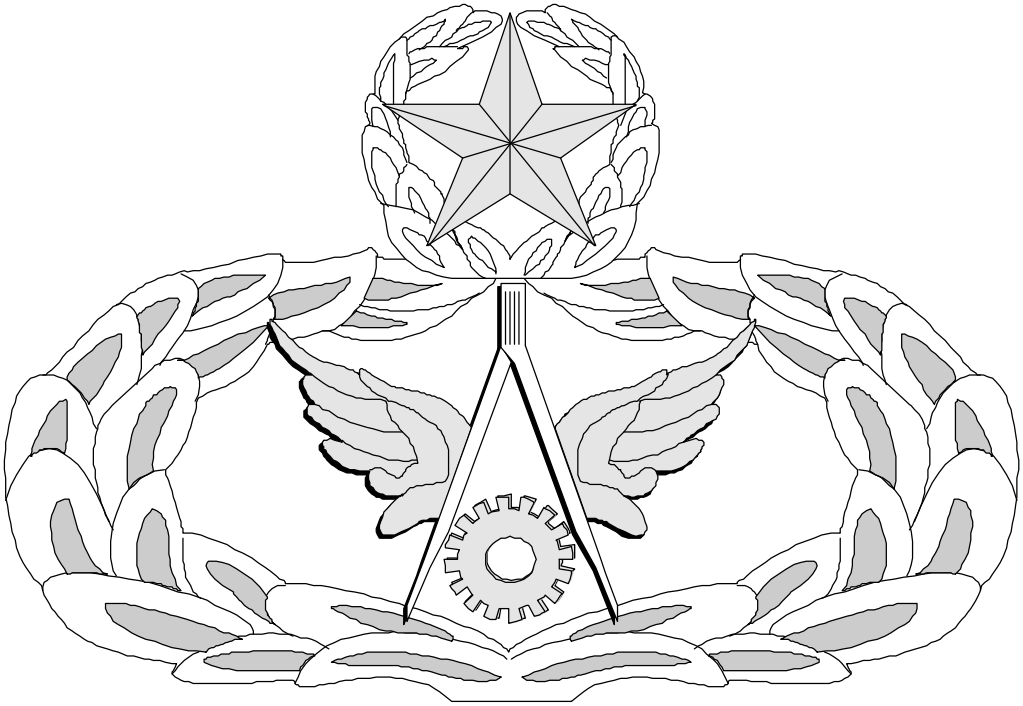
Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For

UTILITIES SYSTEMS

(3E4X1)

MODULE 15

WASTEWATER SYSTEMS

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GRADE TRENCHES/PIPELINES

(3E4X1-15.1.1.1.)

Question	Answer
1. Why are trenches graded?	a. So waste flows through the pipe at the correct velocity
2. Sewers larger than 3 inches in diameter must have a fall of not less than _____.	b. $^{1}/_{8}$ inch per foot
3. What form is used to obtain clearance prior to digging?	a. AF Form 103
4. How far apart should access ladders be placed in a trench?	a. 25 feet
5. What method of grading trenches is more appropriate for large projects?	d. Fixed beam laser.
6. Using the string level method determine how much fall is required if the distance between the stakes is 50 feet, and pipe diameter is 3 inches.	c. $12^{1}/_{2}$ inches
7. What method of grading trenches/pipelines should be used as a last resort?	b. Carpenter's level

PLUNGERS

(3E4X1-15.5.1.1.1.)

Question	Answer
1. What are the two types of plungers?	a. Vacuum plunger and force cup plunger
2. The vacuum plunger is used for what type of restricted drain?	d. All of the above
3. Water closets or urinals with integral traps are best cleared with a _____.	c. Force cup plunger
4. When should you **NOT** use a plunger on a restricted drain?	b. After chemical usage

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POWER AUGERS

(3E4X1-15.5.2.1.1.)

Question	Answer
1. Power augers are used on what kind of clogged lines?	b. Large waste lines
2. What is the feed lever used for?	c. To automatically feed and reverse the cable
3. Before feeding the cable what must you do first?	a. Tighten down automatic feed knob on auger
4. Why do you want to keep excess cable to a minimum?	a. It may damage the cable and/or cause it to kink

SEWER AUGERS

(3E4X1-15.5.2.1.2.)

Question	Answer
1. What is the first and most important action before operating the sewer auger?	b. Review confined space entry procedures
2. Sewer augers are effective in lines up to _____ in diameter.	b. 12”

INTERIOR WASTEWATER SYSTEMS

(3E4X1-15.6.1.)

Question	Answer
1. What equipment is used, when cutting cast iron soil pipe?	d. Chain snap cutter
2. What are the primary types of pipe used for interior wastewater systems?	d. Cast iron soil pipe and plastic pipe.
3. _____ can be used to substitute for cast iron pipe.	b. Plastic
4. Safety precautions are **NOT** a major concern when installing interior wastewater piping.	b. False

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EXTERIOR WASTEWATER SYSTEMS

(3E4X1-15.6.2.)

Question	Answer
1. What two kinds of exterior repairs are there?	b. Temporary and permanent
2. Before installing the clamp on a temporary repair what must you do first?	c. Ensure pipe surface is free of dirt and debris
3. What bolt must you tighten first?	a. Middle and work towards the outer bolts
4. Before you can replace defective sewer pipe what must you do first?	b. Plug outlet of the nearest upstream manhole
5. What determines the method of cutting the pipe?	b. The piping material
6. What determines which repair method you use?	d. The pipe material

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